syringes with needles to administer local anesthetics, and models of teeth to explain oral hygiene.

Working Conditions
Flexible scheduling is a distinctive feature of this job. Full-time, part-time, evening, and weekend schedules are widely available. Dentists frequently hire hygienists to work only 2 or 3 days a week, so hygienists may hold jobs in more than one dental office.

Dental hygienists work in clean, well-lighted offices. Important health safeguards include strict adherence to proper radiological procedures, and use of appropriate protective devices when administering anesthetic gas. Dental hygienists also wear safety glasses, surgical masks, and gloves to protect themselves from infectious diseases.

Employment
Dental hygienists held about 147,000 jobs in 2000. Because multiple jobholding is common in this field, the number of jobs exceeds the number of hygienists. More than half of all dental hygienists worked part time—less than 35 hours a week.

Almost all dental hygienists work in private dental offices. Some work in public health agencies, hospitals, and clinics.

Training, Other Qualifications, and Advancement
Dental hygienists must be licensed by the State in which they practice. To qualify for licensure, a candidate must graduate from an accredited dental hygiene school and pass both a written and clinical examination. The American Dental Association Joint Commission on National Dental Examinations administers the written examination accepted by all States and the District of Columbia. State or regional testing agencies administer the clinical examination. In addition, most States require an examination on legal aspects of dental hygiene practice. Alabama allows candidates to take its examinations if they have been trained through a State-regulated on-the-job program in a dentist's office.

In 2000, the Commission on Dental Accreditation accredited about 256 programs in dental hygiene. Although some programs lead to a bachelor's degree, most grant an associate degree. A dozen universities offer master's degree programs in dental hygiene or a related area.

An associate degree is sufficient for practice in a private dental office. A bachelor's or master's degree usually is required for research, teaching, or clinical practice in public or school health programs.

About half of the dental hygiene programs prefer applicants who have completed at least 1 year of college. However, requirements vary from one school to another. Schools offer laboratory, clinical, and classroom instruction in subjects such as anatomy, physiology, chemistry, microbiology, pharmacology, nutrition, radiography, histology (the study of tissue structure), periodontology (the study of gum diseases), pathology, dental materials, clinical dental hygiene, and social and behavioral sciences.

Dental hygienists should work well with others and must have good manual dexterity because they use dental instruments within a patient's mouth, with little room for error. High school students interested in becoming a dental hygienist should take courses in biology, chemistry, and mathematics.

Job Outlook
Employment of dental hygienists is expected to grow much faster than the average for all occupations through 2010, in response to increasing demand for dental care and the greater substitution of the services of hygienists for those previously performed by dentists. Job prospects are expected to remain very good unless the number of dental hygienist program graduates grows much faster than during the last decade, and results in a much larger pool of qualified applicants.

Population growth and greater retention of natural teeth will stimulate demand for dental hygienists. Older dentists, who are less likely to employ dental hygienists, will leave and be replaced by recent graduates, who are more likely to do so. In addition, as dentists' workloads increase, they are expected to hire more hygienists to perform preventive dental care such as cleaning, so that they may devote their own time to more profitable procedures.

Earnings
Median hourly earnings of dental hygienists were $24.68 in 2000. The middle 50 percent earned between $20.46 and $29.72 an hour. The lowest 10 percent earned less than $15.53, and the highest 10 percent earned more than $35.39 an hour.

Earnings vary by geographic location, employment setting, and years of experience. Dental hygienists who work in private dental offices may be paid on an hourly, daily, salary, or commission basis.

Benefits vary substantially by practice setting, and may be contingent upon full-time employment. According to the American Dental Association's 1999 Workforce Needs Assessment Survey, almost all full-time dental hygienists employed by private practitioners received paid vacation. The survey also found that 9 out of 10 full- and part-time dental hygienists received dental coverage. Dental hygienists who work for school systems, public health agencies, the Federal Government, or State agencies usually have substantial benefits.

Related Occupations
Workers in other occupations supporting health practitioners in an office setting include dental assistants, medical assistants, occupational therapist assistants and aides, physical therapist assistants and aides, physician assistants, and registered nurses.

Sources of Additional Information
For information on a career in dental hygiene and the educational requirements to enter this occupation, contact:

➤ Division of Professional Development, American Dental Hygienists' Association, 444 N. Michigan Ave., Suite 3400, Chicago, IL 60611. Internet: **http://www.adha.org**

For information about accredited programs and educational requirements, contact:

➤ Commission on Dental Accreditation, American Dental Association, 211 E. Chicago Ave., Suite 1814, Chicago, IL 60611. Internet: **http://www.ada.org**

The State Board of Dental Examiners in each State can supply information on licensing requirements.

Diagnostic Medical Sonographers

(O*NET 29-2032.00)

Significant Points

- Sonographers should experience favorable job opportunities as ultrasound becomes an increasingly attractive alternative to radiologic procedures.
- More than half of all sonographers are employed by hospitals, and most of the remainder work in physicians' offices and clinics, including diagnostic imaging centers.
- Beginning in 2005, an associate or higher degree from an accredited program will be required for registration.

Nature of the Work

Diagnostic imaging embraces several procedures that aid in diagnosing ailments, the most familiar being the x ray. Another increasingly common diagnostic imaging method, called magnetic resonance imaging (MRI), uses giant magnets and radio waves rather than radiation to create an image. Not all imaging technologies use ionizing radiation or radio waves, however. Sonography, or ultrasonography, is the use of sound waves to generate an image used for assessment and diagnosis of various medical conditions. Many people associate sonography with obstetrics and the viewing of the fetus in the womb. But this technology has many other applications in the diagnosis and treatment of medical conditions.

Diagnostic medical sonographers, also known as *ultrasonographers*, use special equipment to direct nonionizing, high frequency sound waves into areas of the patient's body. Sonographers operate the equipment, which collects reflected echoes and forms an image that may be videotaped, transmitted, or photographed for interpretation and diagnosis by a physician.

Sonographers begin by explaining the procedure to the patient and recording any additional medical history that may be relevant to the condition being viewed. They then select appropriate equipment settings and direct the patient to move into positions that will provide the best view. To perform the exam, sonographers use a transducer, which transmits sound waves in a cone- or rectangle-shaped beam. Although techniques vary based on the area being examined, sonographers usually spread a special gel on the skin to aid the transmission of sound waves.

Viewing the screen during the scan, sonographers look for subtle visual cues that contrast healthy areas from unhealthy ones. They decide whether the images are satisfactory for diagnostic purposes and select which ones to show to the physician.

Diagnostic medical sonographers may specialize in obstetric and gynecologic sonography (the female reproductive system), abdominal sonography (the liver, kidneys, gallbladder, spleen, and pancreas), neurosonography (the brain), or ophthalmologic sonography (the eyes). In addition, sonographers also may specialize in vascular technology or echocardiography. (Vascular technologists and echocardiographers are covered in the *Handbook* statement on cardiovascular technologists and technicians.)

Obstetric and gynecologic sonographers specialize in the study of the female reproductive system. This includes one of the more well known uses of sonography: examining the fetus of a pregnant woman to track its growth and health.

Abdominal sonographers inspect a patient's abdominal cavity to help diagnose and treat conditions involving primarily the gallbladder, bile ducts, kidneys, liver, pancreas, and spleen. Abdominal sonographers also are able to scan parts of the heart, although diagnosis of the heart using ultrasound usually is done by echocardiographers.

Neurosonographers use ultrasound technology to focus on the nervous system, including the brain. In neonatal care, neurosonographers study and diagnose neurological and nervous system disorders in premature infants. They also may scan blood vessels to check for abnormalities indicating a stroke in infants diagnosed with sickle cell anemia. Like other sonographers, neurosonographers operate transducers to perform the ultrasound, but use different frequencies and beam shapes than obstetric and abdominal sonographers.

Ophthalmologic sonographers use ultrasound to study the eyes. Ultrasound aids in the insertion of prosthetic lenses by allowing accurate measurement of the eyes. Ophthalmologic ultrasound also helps diagnose and track tumors, blood supply conditions, separated retinas, and other ailments of the eye and the surrounding tissue. Ophthalmologic sonographers use high frequency transducers made exclusively to study the eyes, which are much smaller than those used in other specialties.

A diagnostic medical sonographer examines a patient using a transducer, creating images with sound waves.

In addition to working directly with patients, diagnostic medical sonographers keep patient records and adjust and maintain equipment. They also may prepare work schedules, evaluate equipment purchases, or manage a sonography or diagnostic imaging department.

Working Conditions

Most full-time sonographers work about 40 hours a week; they may have evening weekend hours and times when they are on call and must be ready to report to work on short notice.

Sonographers typically work in healthcare facilities that are clean and well lit. Some travel to patients in large vans equipped with sophisticated diagnostic equipment. Sonographers are on their feet for long periods and may have to lift or turn disabled patients. They work at diagnostic imaging machines but may also do some procedures at patients' bedsides.

Employment

Diagnostic medical sonographers held about 33,000 jobs in 2000. More than half of all sonographer jobs are in hospitals. Most of the rest are in physicians' offices and clinics, primarily in offices

specializing in obstetrics and in diagnostic imaging centers. According to the 2000 Sonography Benchmark Survey conducted by the Society of Diagnostic Medical Sonographers (SDMS), about three out of four sonographers worked in urban areas.

Training, Other Qualifications, and Advancement

There are several avenues for entry into the field of diagnostic medical sonography. Sonographers may train in hospitals, vocational-technical institutions, colleges and universities, and the Armed Forces. Some training programs prefer applicants with a background in science or experience in other health professions, but also will consider high school graduates with courses in math and science, as well as applicants with liberal arts backgrounds.

Colleges and universities offer formal training in both 2- and 4-year programs, culminating in an associate or bachelor's degree. Two-year programs are most prevalent. Course work includes classes in anatomy, physiology, instrumentation, basic physics, patient care, and medical ethics. The Joint Review Committee on Education for Diagnostic Medical Sonography accredits most formal training programs—76 programs in 1999.

Some health workers, such as obstetric nurses and radiologic technologists, seek to increase their marketability by cross-training in fields such as sonography. Many take 1-year programs resulting in a certificate. Additionally, sonographers specializing in one discipline often seek competency in others; for example, obstetric sonographers might seek training in and exposure to abdominal sonography to broaden their opportunities.

While no State requires licensure in diagnostic medical sonography, the American Registry of Diagnostic Medical Sonographers (ARDMS) certifies the competency of sonographers through registration. Because registration provides an independent, objective measure of an individual's professional standing, many employers prefer to hire registered sonographers. Registration with ARDMS requires passing a general physics and instrumentation examination, in addition to passing an exam in a specialty such as obstetrics/gynecology, abdominal, or neurosonography.

While formal education is not necessary to take the exams, an associate or bachelor's degree from an accredited program is preferred. Beginning in 2005, ARDMS will consider for registration only those holding an associate or higher degree. To keep their registration current, sonographers must complete 30 hours of continuing education every 3 years to stay abreast of advances in the occupation and in technology.

Sonographers need good communication and interpersonal skills because they must be able to explain technical procedures and results to their patients, some of whom may be nervous about the exam or the problems it may reveal. They also should have some background in math and science, especially when they must perform mathematical and scientific calculations in analyses for diagnosis.

Job Outlook

Employment of diagnostic medical sonographers is expected to grow faster than the average for all occupations through 2010 as the population grows and ages, increasing the demand for diagnostic imaging and therapeutic technology. Some job openings also will arise from the need to replace sonographers who leave the occupation.

Ultrasound is becoming an increasingly attractive alternative to radiologic procedures as patients seek safer treatment methods. Because ultrasound—unlike most diagnostic imaging methods—does not involve radiation, harmful side effects and complications from repeated use are rarer for both the patient and the sonographer. Sonographic technology is expected to evolve rapidly and to spawn many new ultrasound procedures, such as 3D-ultrasonography for use in obstetric and ophthalmologic diagnosis. However, high costs may limit the rate at which some promising new technologies are adopted.

Hospitals will remain the principal employer of diagnostic medical sonographers. However, employment is expected to grow more rapidly in offices and clinics of physicians, including diagnostic imaging centers. Health facilities such as these are expected to grow very rapidly through 2010 due to the strong shift toward outpatient care, encouraged by third-party payers and made possible by technological advances that permit more procedures to be performed outside the hospital.

Earnings

Median annual earnings of diagnostic medical sonographers were $44,820 in 2000. The middle 50 percent earned between $38,390 and $52,750 a year. The lowest 10 percent earned less than $32,470, and the highest 10 percent earned more than $59,310. Median annual earnings of diagnostic medical sonographers in 2000 were $43,950 in hospitals and $46,190 in offices and clinics of medical doctors.

Related Occupations

Diagnostic medical sonographers operate sophisticated equipment to help physicians and other health practitioners diagnose and treat patients. Workers in related occupations include cardiovascular technologists and technicians, clinical laboratory technologists and technicians, nuclear medicine technologists, radiologic technologists and technicians, and respiratory therapists.

Sources of Additional Information

For more information on a career as a diagnostic medical sonographer, contact:

➤ Society of Diagnostic Medical Sonographers, 2745 N. Dallas Parkway, Suite 350, Plano, TX 75093-8729. Internet: **http://www.sdms.org**

➤ The American Registry of Diagnostic Medical Sonographers, 600 Jefferson Plaza, Suite 360, Rockville, MD 20852-1150. Internet: **http://www.ardms.org**

For a current list of accredited education programs in diagnostic medical sonography, write to:

➤ The Joint Review Committee on Education in Diagnostic Medical Sonography, 1248 Harwood Rd., Bedford, TX 76021-4244. Internet: **http://www.caahep.org**

Emergency Medical Technicians and Paramedics

(O*NET 29-2041.00)

Significant Points

- Job stress is common due to irregular hours and treating patients in life-or-death situations.
- Formal training and certification are required but State requirements vary.
- Employment is projected to grow faster than average as paid emergency medical technician positions replace unpaid volunteers.

Nature of the Work

People's lives often depend on the quick reaction and competent care of emergency medical technicians (EMTs) and paramedics, EMTs with additional advanced training to perform more difficult